Fisheries and Oceans Canada | Pêches et Océans Canada

NOAA FISHERIES
NATIONAL MARINE FISHERIES SERVICE

CERT

Comité d'évaluation des ressources transfrontalières

Document de référénce 2010/09

Ne pas citer sans
autorisation des auteurs

TRAC

Transboundary Resources Assessment Committee

Reference Document 2010/09

Not to be cited without
permission of the authors

Update of Allocation Shares for Canada and the USA of the Transboundary Resources of Atlantic Cod, Haddock and Yellowtail Flounder on Georges Bank Through Fishing Year 2011

L. Van Eeckhaute[1] and L. O'Brien[2]

[1]Fisheries and Oceans Canada
531 Brandy Cove Road
St. Andrews, New Brunswick E5B 3L9
Canada

[2]NOAA/NMFS Northeast Fisheries Science Center
166 Water Street
Woods Hole, Massachusetts 02543-1097
USA

Ce document est disponible sur l'Internet à : This document is available on the Internet at :
http://www.mar.dfo-mpo.gc.ca/science/TRAC/trac.html

Canada

TABLE OF CONTENTS

Abstract / Résumé ii

Introduction 1

Data and Methods 1
Formula 1
Resource Utilization 2
Resource Distribution 2

Results 3

Discussion 4

References 5

Tables 7

Figures 22

ABSTRACT

Development of consistent management by Canada and the USA for the transboundary resources of Atlantic cod, haddock and yellowtail flounder on Georges Bank led to a sharing allocation agreement. For Atlantic cod and haddock the agreement is limited to the eastern Georges Bank management unit (Department of Fisheries and Oceans (DFO) Statistical Unit Areas 5Zj and 5Zm; United States of America (USA) Statistical Areas 551, 552, 561 and 562). The management unit for yellowtail flounder encompasses the entire Georges Bank east of the Great South Channel (DFO Statistical Unit Areas 5Zh, 5Zj, 5Zm and 5Zn; USA Statistical Areas 522, 525, 551, 552, 561 and 562). Two principles are incorporated in the sharing formulae to account for both historical utilization, based on reported landings during 1967 through 1994, and temporal changes in resource distributions, determined from NMFS and DFO survey results that are updated annually. From 2010 onward, utilization will account for 10% and distribution for 90% of the allocation. This report uses the 2009 NMFS and DFO survey results to update the calculation for the 2011 fishing year allocations.

The effect on the biomass indices and on the allocation of the very large catch of yellowtail flounder on the Canadian side in each of the 2008 and 2009 DFO surveys was investigated. Leaving out the tow had a greater impact in 2008 than in 2009, where the effect was negligible. After combining the three survey distributions and then applying the smoothing algorithm, there was no change in the allocation for the 2011 fishing year.

The resource distributions in 2009 were: 83% Canada, 17% USA for Atlantic cod; 57% Canada, 43% USA for haddock; and 50% Canada, 50% USA for yellowtail flounder. The 2011 fishing year allocations (calendar year for Canada; May 1, 2011 to April 30, 2012 for the USA), updated with the 2009 resource distributions, resulted in shares for Atlantic cod of 81% Canada, 19% USA, for haddock 57% Canada, 43% USA, and for yellowtail flounder 45% Canada, 55% USA.

RÉSUMÉ

Soucieux de gérer de manière cohérente les stocks transfrontaliers de morue, d'aiglefin et de limande à queue jaune du banc Georges, le Canada et les États-Unis ont conclu une entente de partage de la ressource. Pour la morue et l'aiglefin, l'entente se limite à l'unité de gestion de l'est du banc Georges (unités statistiques 5Zj et 5zm du MPO et unités statistiques 551, 552, 561 et 562 des États Unis) Quant à l'unité de gestion de la limande à queue jaune, elle comprend toute la partie du banc Georges située à l'est du Grand chenal Sud (unités statistiques 5Zh, 5Zj, 5Zm et 5Zn du MPO et unités statistiques 522, 525, 551, 552, 561 et 562 des États-Unis). Deux principes ont été intégrés à la formule de calcul des parts afin de tenir compte à la fois de l'utilisation historique de la ressource, d'après les débarquements déclarés de 1967 à 1994, et des changements temporels dans la répartition de la ressource, d'après les résultats des relevés du NMFS et du MPO, qui sont mis à jour chaque année. À compter de 2010, l'utilisation de la ressource comptera pour 10 % et la répartition pour 90 % dans le calcul des parts. Ce rapport utilise les résultats des relevés du NMFS et du MPO de 2009 pour calculer les parts pour la saison de pêche de 2011.

On a étudié l'effet des très importantes captures de limande à queue jaune effectuées côté canadien lors des relevés de 2008 et de 2009 du MPO, sur les indices de biomasse et le calcul des parts. En ne tenant pas compte de ces captures, les conséquences étaient plus importantes en 2008 qu'en 2009, où elles étaient négligeables. Après avoir combiné les répartitions des trois stocks d'après les relevés et appliqué l'algorithme de lissage, aucun changement n'était apporté aux parts pour l'année de pêche de 2011.

La ressource était répartie comme suit en en 2009 : en ce qui concerne la morue, 83 % au Canada et 17 % aux États Unis; en ce qui concerne l'aiglefin, 57 % au Canada et 43 % aux États Unis et en ce qui concerne la limande à queue jaune, 50 % au Canada et 50 % aux États Unis. Les parts pour l'année de pêche de 2011 (année civile pour le Canada et période du 1er mai 2011 au 30 avril 2012 pour les États Unis) calculées en tenant compte de la répartition de la ressource en 2009, ont été établies comme suit : en ce qui concerne la morue, 81 % pour le Canada et 19 % pour les États Unis; en ce qui concerne l'aiglefin, 57 % pour le Canada et 43 % pour les États Unis et en ce qui concerne la limande à queue jaune, 45 % pour le Canada et 55 % pour les États Unis.

INTRODUCTION

The designation of units for management entails a compromise between the biological realities of stock structure and the practical convenience of analysis and policy making (Gulland 1980). For yellowtail flounder, Canada and the United States of America (USA) use a common management unit (for Department of Fisheries and Oceans Canada (DFO) Statistical Unit Areas 5Zh, 5Zj, 5Zm and 5Zn; for USA Statistical Areas 522, 525, 551, 552, 561 and 562) encompassing the entire bank east of the Great South Channel (Figure 1), referred to hereafter as Georges Bank. For Atlantic cod and haddock, the USA employs a management unit comprising all of Georges Bank and extending south and west of Cape Cod, while Canada uses only the eastern portion of Georges Bank. The Transboundary Management Guidance Committee (TMGC) agreed that, for the purpose of developing a sharing formula for Atlantic cod and haddock, the management unit would be limited to the eastern portion of Georges Bank (Figure 1; DFO Statistical Unit Areas 5Zj and 5Zm; USA Statistical Areas 551, 552, 561 and 562), referred to as eastern Georges Bank.

Principles of resource sharing for transboundary stocks include consideration of access to resources occurring or produced within national boundaries and historical participation in exploitation of the resources (Gavaris and Murawski 2004). The former has emerged from the effective property rights associated with Exclusive Economic Zones as well as the distribution of stocks occurring in areas under national jurisdiction (UN 1995). The latter recognizes traditional involvement and investment in the development of a fishery. Both principles were incorporated in the TMGC sharing proposal but historical participation was gradually down weighted so that after an eight year phase-in period, the annual allocation would be based primarily on resource distribution (90%).

Details for calculating the national allocations for Canada and the USA were described by Murawski and Gavaris (2004). The approach incorporates both resource utilization and resource distributions relative to the USA/Canada east coast maritime boundary. Results for fishing years 2006 to 2010 have been reported annually (Gavaris et al 2009). This report uses the 2009 USA National Marine Fisheries Service (NMFS) and DFO survey results to update the calculation of the 2011 fishing year allocations.

DATA AND METHODS

Formula

The TMGC (DFO 2002) agreed approach for calculating the respective country shares that takes into consideration historical utilization and adapts to shifts in resource distribution, is as follows:

$$\%share_{year,country} = (\alpha_{year} \times \%utilization_{year,country}) + (\beta_{year} \times \%resource\ distribution_{year,country})$$

where α_{year} = percentage weighting for utilization in year

β_{year} = percentage weighting for resource distribution in year

$\alpha_{year} + \beta_{year} = 100\%$

The initial sharing formula was based on the weighting of resource distribution from surveys by 60% and country utilization by 40%. Thereafter, the percentage weighting was changed in 5% annual increments until the weightings reached 90% resource distribution from surveys and

10% country utilization from landings. This agreement was implemented in 2003, with the end of the transition to a 90/10 weighting in the 2010 fishing year according to the following schedule:

2003	2004	2005	2006	2007	2008	2009	2010
60/40	60/40	65/35	70/30	75/25	80/20	85/15	90/10

Resource Utilization

Historical participation in exploitation of these resources was assessed for the three species using landings records (Table 1). The TMGC agreed to use the percentage of the total 1967-1994 landings inclusive, by country, as the measure of country utilization.

Resource Distribution

Resource distribution patterns were determined from three research vessel bottom trawl survey time series conducted by the NMFS and DFO. Surveys of Georges Bank have been conducted by NMFS each fall (October) since 1963 and each spring (April) since 1968, and by DFO since 1986 (February).

Before 2009, two vessels (*FRV Albatross* and *FRV Delaware*) were used to conduct NMFS surveys and a trawl door change occurred in 1985. Vessel and door conversion factors, derived from comparative fishing experiments (Forrester *et al.* 1997), were applied to the survey results to make the series consistent. Additionally, two different trawl nets were used on the NMFS spring surveys, a modified Yankee 41 during 1973-81 and a Yankee 36 in all other years, but no conversion factors are available.

Starting in 2009, NMFS surveys were conducted by the *FSV Henry B. Bigelow*, using a different net (3-bridle, 4 seam) and revised protocols. Given that the allocation is based on proportions of biomass distribution within a survey, the use of biomass-based conversion coefficients is not necessary, i.e. proportions would not change if survey indices were calibrated by a constant. As the conversion coefficients are length based, differences in fishing power between the vessels could potentially affect biomass estimates if there were large disparities in length composition on each side of the Hague Line. However, when length frequencies from the two jurisdictions were compared the differences were minor and application of a length-weight relationship to the length frequencies produced negligible differences in biomass.

The Canadian Coast Guard Ship (CCGS) *Alfred Needler* is the standard vessel used for the DFO Georges Bank survey, but, due to unavailability of the *Alfred Needler*, the CCGS *Wilfred Templeman*, a sister ship to the *Alfred Needler*, has been used in several years, 1993, 2004, 2007 and 2008. No conversion factors are available for the *Templeman*, however, this vessel is considered to be similar in fishing strength to the *Needler*.

Swept area biomass, considered a relative index of abundance, was computed for each stratum and apportioned to USA and Canadian sectors in each year. DFO survey sampling strata were revised in 1987 to incorporate the international boundary and thus only results since 1987 were used. Since the survey designs are based on randomization within strata, the data were post-stratified to USA and Canadian zones within the existing survey strata. Strata used for cod and haddock were also divided by the management unit boundary. The strata and "strata sections" on each side of the international boundary in the management units used in the analysis are depicted in Figure 2 and the strata areas listed in Table 2.

Estimates of biomass indices were calculated for entire strata and for strata sections unless no observations occurred within a stratum (Tables 3-11). On the few occasions where no observations were available in a stratum section, density and distribution patterns from adjacent areas and years were used as substitute values. The magnitude of these derived values was generally small and did not unduly influence results. When such values are combined over surveys, they have only a minor effect on the annual aggregate biomass index estimates within the transboundary management units. The swept area biomasses for each groundfish species were individually summed to derive the biomass index on the USA and Canadian side for each management unit. Age and size specific distribution patterns were ignored in developing the biomass indices.

The biomass index estimate derived from each survey represents a synoptic snapshot of resource distribution at a specific time during a year. Combining the results of multiple surveys requires an understanding of seasonal movement patterns and how much of the biological year each survey represents. For Atlantic cod, the DFO and the NMFS spring surveys in each year were averaged to characterize the distribution during the winter-spring period. This result was then averaged with the NMFS fall distribution percentage, thereby giving equal weight to the winter-spring and summer-fall periods. Prior to initiation of the DFO survey in 1987, the NMFS spring survey was used alone to characterize the winter-spring period. For haddock and yellowtail flounder, the results from all three surveys in each year were averaged to represent the annual distribution pattern. Prior to 1987, only the NMFS spring and fall surveys were averaged to represent the annual distribution pattern.

A robust locally weighted regression algorithm (Cleveland 1979), referred to as LOESS, was adopted for removing both unpredictable fluctuations and sampling variation from the survey observations. A 30% smoothing parameter was chosen as it established current trends, was responsive to changes, and provided the most appropriate results for contemporary resource sharing. The recommended default (Cleveland 1979) of two robustness iterations was also adopted. Resource distributions are updated annually by incorporating data from the latest surveys and dropping data from the earliest survey used in the previous year (2009 and 1976, respectively, in this case) so that a 33 year window is maintained. After the surveys were combined, the LOESS smoother was applied to the 1977 to 2009 survey data. The fixed resource utilization (10% weighting) and the 2009 resource distributions (90% weighting) were applied to the agreed sharing formula to determine national allocation shares of each of the three transboundary groundfish species for the fishing year two years ahead (2011).

RESULTS

The country utilization aspect of the sharing formula, based on each country's landings during the period of 1967-1994 (Table 1), resulted in the following percentage weightings for utilization:

	USA	CANADA
Eastern Georges Bank Atlantic cod	40%	60%
Eastern Georges Bank haddock	45%	55%
Georges Bank yellowtail	98%	2%

The 2010 fishing year is the end of the transition to a 90/10 weighting of resource distribution and country utilization. Historical participation will now account for 10% of the sharing formula.

The biomass indices in 2009 for the NMFS spring and fall surveys and the DFO survey are given in Tables 3 to 11 and Figures 3, 4 and 5. For 2009 surveys, it was not necessary to derive

any values for missing values. In 2009, in the DFO survey, no cod or haddock were caught in stratum 5Z3, a USA stratum, even though there were seven tows in that stratum. Stratum 5Z4, also a USA stratum, had a very low biomass of cod and haddock. The biomass of yellowtail flounder was also extremely low in both of these USA strata and, as in 2008, was coincident with an exceptionally large catch of yellowtail flounder on the Canadian side. The percentage of yellowtail flounder on the Canadian side has generally been highest during the NMFS spring survey, but, in 2008 and 2009, the distribution was strongly skewed towards the Canadian side for the DFO survey. As a result, in 2009, the biomass of all 3 species on the USA side was at the lowest level observed in the DFO survey series.

The resource distributions for the three surveys, for the combined surveys and the results from the smoothing algorithm for the most recent 33 year time period, with the terminal year being 2009 are given in Tables 12, 13 and 14, for cod, haddock, and yellowtail flounder, respectively, and Figure 6. The smoothed percentages for 2009 differ slightly from those previously presented (Murawski and Gavaris 2004, Gavaris 2009), due to dropping the earliest year of survey data and the incorporation of the next recent year of survey data in the smoothing algorithm. The resulting smoothed resource distributions for eastern Georges Bank in 2009 were, for cod, 83% Canada, 17% USA; for haddock, 57% Canada, 43% USA; and for yellowtail flounder, 50% Canada, 50% USA (Figure 6).

The 2009 resource distributions, after smoothing, and the fixed resource utilization were applied to the agreed sharing formula resulting in shares for the 2011 fishing year (calendar year for Canada; May 1, 2011 to April 30, 2012, for the USA) for Atlantic cod of 81% Canada, 19% USA; for haddock of 57% Canada, 43% USA; and for yellowtail flounder of 45% Canada, 55% USA (Table 15).

DISCUSSION

The abundance of Atlantic cod declined in the mid 1980s and the biomass index in USA waters declined markedly, particularly in the NMFS fall survey (Figure 3). Most of the Atlantic cod biomass during the NMFS spring surveys (Table 3) and the DFO surveys (Table 5) was located on the top of the Bank in shallower depths (in NMFS survey strata 16, 19 and 20, although, 19 and 20 were more important in the 1970's and early 1980's and have now declined in importance, and DFO survey stratum 5Z2). The deeper slope strata have always been more important for Atlantic cod in the NMFS fall survey than in the spring surveys (Table 4), but, after the late 1980s, these strata (particularly the deeper water on the Canadian side of NMFS survey strata 21 and 17, although with high variability for stratum 17) became even more important as biomass shifted away from the top of the Bank. The percentage of Atlantic cod in Canadian waters during the NMFS spring and DFO surveys has generally been lower than the percentage during the NMFS fall surveys. This difference has become more pronounced since the mid 1980s (Table 12, Figure 3).

Haddock abundance peaked during the early 1960s, was high again in the late 1970s and increased during the 1990s and rose to a very high level in the 2000s (Figure 4). The biomass index in USA waters was exceptionally high during the 1960s, and, coincident with the increase in haddock abundance in recent years, the percentage in USA waters in the NMFS surveys, especially in the spring, has increased. As with Atlantic cod, haddock biomass is concentrated on top of the Bank during both the NMFS and DFO spring surveys (Tables 6 and 8). Since the 1970s, haddock biomass in the fall NMFS surveys has been concentrated in the deeper slope strata in Canadian waters. Stratum 19, entirely in USA waters, was important only in the early part of the fall series (Table 7). The percentage of haddock on each side of the Canada/USA

boundary from the DFO survey is generally somewhat intermediate between the NMFS fall and NMFS spring survey results but reached 100% in Canadian waters in 2009 (Table 13, Figure 4).

Yellowtail flounder survey abundance was high in the 1960s, declined and remained low during the 1970s and 1980s, increased during the 1990s, declined and then increased to 1960's levels in 2009 (Figure 5). The biomass index in USA waters was highest during the 1960s. In all three survey series (Tables 9-11), yellowtail flounder biomass has been highest on the southern flank of the Bank at the shallower depths in NMFS survey strata 13 and 16 and in DFO survey strata 5Z2 and 5Z4. NMFS survey stratum 19, a shallow depth stratum near the middle of the bank, was important during the 1960s only. A change in distribution occurred in 2008 and 2009 during the DFO survey due to large catches in Canadian waters and to the substantial decrease in catches on the USA side in those years. While the large yellowtail catches in 2008 and 2009 had an appreciable influence on the overall abundance index for the stock (Table 11, Figure 5), their impact on the estimated biomass distribution was less (Table 14). The percentage of yellowtail flounder biomass estimated in Canadian waters from the 2008 DFO survey was 98% with the large catch included and 71% with the large catch excluded and for the 2009 DFO survey was 100% with the large catch included and 99% with the large catch excluded. Leaving out the large tows had a greater impact in 2008 than in 2009, where the effect was negligible and was due mostly to the decrease in biomass in USA waters. Averaging the 2008 and 2009 DFO surveys with the NMFS spring and fall surveys and subjecting the result to the smoothing algorithm produced no change in the yellowtail flounder allocation, whether the large tows were included or not. Such fluctuations have been observed in the past and the averaging/smoothing algorithm appears to adequately handle them (Figure 6).

The percentage of biomass of eastern Georges Bank cod in Canadian waters, as indicated by the combined, smoothed results, progressively increased from about 60% in the late 1970s to about 80% in the late 1980s, fluctuated between 83% and 85% until 2003, declined slightly then increased to 83% in 2009. The percentage of biomass of eastern Georges Bank haddock in Canadian waters fluctuated around 80% from the late 1970s and 1980s to almost 90% in the mid 1990s, and with the large increase in biomass, has subsequently declined to 57%. The percentage of Georges Bank yellowtail flounder biomass in Canadian waters was at a low of 25% in 1981, gradually increased through the 1980s and most of the 1990s to about 50%, declined to 36% in 2005, but has recently increased to 50% (Tables 12 to 14, Figure 6).

Consistent fisheries management advice utilizing the allocation sharing arrangement was provided for the first time in the 2003 TMGC Guidance Document (TMGC 2003) for application to the 2004 fishing year quotas and subsequently in the 2004 - 2009 TMGC Guidance Documents for application to the 2005 - 2010 fishing year quotas (TMGC 2009). However, in 2009, due to the inability of TMGC to come to an agreement on the yellowtail flounder quota, the allocation sharing arrangement for 2010 for yellowtail flounder was not adhered to. It is recognized that the analyses are based on calendar year data but that the fishing year for USA fisheries starts 1 May and ends 30 April. The fishing year for Canadian fisheries starts 1 January and ends 31 December.

REFERENCES

Cleveland, W.S. 1979. Robust locally weighted regression and smoothing scatterplots. Journal of American Statistical Association 74: 829-836.

DFO. 2002. Development of a sharing allocation proposal for transboundary resources of cod, haddock and yellowtail flounder on Georges Bank. DFO Maritime Provinces, Regional Fisheries Management Report 2002/01.

Forrester, J.R.S., C.J. Byrne, M.J. Fogarty, M.P. Sissenwine, and E.W. Bowman. 1997. Background papers on USA vessel, trawl, and door conversion studies. SAW/SARC 24 Working Paper Gen 6. Northeast Fisheries Science Center, Woods Hole, MA.

Gavaris, S., and S.A. Murawski. 2004. The role and determination of residence proportions for fisheries resources across political boundaries: the Georges Bank example; pp. 261-278. In: A.I.L. Payne, C.M. O'Brien, and S.I. Rogers [eds.] Management of Shared Fish Stocks. Blackwell. Oxford, UK.

Gavaris, S., L. O'Brien, and L. Van Eeckhaute. 2009. Update of allocation shares for Canada and the USA of the transboundary resources of Atlantic cod, haddock and yellowtail flounder on Georges Bank through fishing year 2010. TRAC Ref. Doc. 2009/05.

Gulland, J.A. 1980. Some problems of the management of shared stocks. FAO Fish. Tech. Pap. 206.

Murawski, S.A., and S. Gavaris. 2004. Computation of allocation shares for Canada and the USA of the transboundary resources of Atlantic cod, haddock and yellowtail flounder on Georges Bank. TRAC Ref. Doc. 2004/05.

TMGC. 2003. Transboundary Management Guidance Document. Guidance Doc. 2003/1.

TMGC. 2009. Transboundary Management Guidance Document. Guidance Doc. 2009/1.

UN. 1995. United Nations conference on straddling fish stocks and highly migratory fish stocks. Agreement for the implementation of the provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the conservation and management of straddling fish stocks and highly migratory fish stocks. U.N. Doc. A/Conf./164/37.

Table 1. Landings of cod, haddock and yellowtail flounder from the transboundary management units on Georges Bank (see Figure 1).

	Eastern Georges Bank Cod			Eastern Georges Bank Haddock			Georges Bank Yellowtail Flounder		
	Canada	USA	Total	Canada	USA	Total	Canada	USA	Total
1967	8188	3115	11303	12999	11999	24998	133	8407	8540
1968	9055	3244	12299	9195	7646	16841	122	12799	12921
1969	5876	3676	9552	3941	6621	10562	327	15944	16271
1970	2580	3211	5791	1970	3154	5124	70	15505	15575
1971	2950	4389	7339	1610	3533	5143	102	11878	11980
1972	2535	2708	5243	609	1551	2160	8	14157	14165
1973	3222	3064	6286	1565	1396	2961	12	15899	15911
1974	1370	3792	5162	462	955	1417	5	14607	14612
1975	1833	3108	4941	1353	1705	3058	8	13205	13213
1976	2320	2037	4357	1362	974	2336	11	11336	11347
1977	6156	4256	10412	2871	2428	5299	38	9444	9482
1978	8777	5502	14279	9968	4724	14692	56	4519	4575
1979	5979	6408	12387	5080	5212	10292	17	5475	5492
1980	8065	6418	14483	10017	5615	15632	81	6481	6562
1981	8498	8092	16590	5658	9075	14733	12	6182	6194
1982	17825	8565	26390	4872	6280	11152	18	10634	10652
1983	12131	8573	20704	3208	4453	7661	43	11350	11393
1984	5761	10551	16312	1463	5120	6583	4	5764	5768
1985	10442	6641	17083	3484	1684	5168	3	2477	2480
1986	8411	5697	14108	3415	2201	5616	27	3041	3068
1987	11844	4793	16637	4703	1418	6121	56	2743	2799
1988	12740	7645	20385	5941	1694	7635	47	1866	1913
1989	7895	6182	14077	3060	785	3845	32	1134	1166
1990	14364	6414	20778	3340	1188	4528	13	2751	2764
1991	13459	6353	19812	5423	931	6354	25	1784	1809
1992	11673	5080	16753	4090	1629	5719	15	2859	2874
1993	8524	4027	12551	3725	424	4149	675	2089	2764
1994	5278	1229	6507	2412	32	2444	2139	1589	3728
1995	1099	638	1737	2062	22	2084	470	410	880
1996	1921	757	2678	3666	35	3701	472	777	1249
1997	2919	551	3470	2749	47	2796	809	969	1778
1998	1893	828	2721	3362	311	3673	1175	1836	3011
1999	1818	1151	2969	3679	355	4034	1992	2066	4058
2000	1572	662	2234	5402	188	5590	2860	3678	6538
Totals 1967-94									
	217751	144770	362521	117796	94427	212223	4099	215919	220018
Percentage 1967-94									
	60.1%	39.9%		55.5%	44.5%		1.9%	98.1%	

Table 2. Strata (or strata section) areas used in the calculation of biomass indices. The designation 'eGB' denotes the eastern Georges Bank management unit used for cod and haddock. The designation '~eGB' denotes the portion of the stratum not in the eastern Georges Bank management unit.

	Canada (sq. nm.)	USA(eGB) (sq. nm.)	USA(~eGB) (sq. nm.)
	DFO Strata		
5Z1	795	0	0
5Z2	1252	0	0
5Z3	0	1504	791
5Z4	0	1350	1729
	NMFS Strata		
13	0	0	2374
14	0	0	656
15	0	0	230
16	1553	1427	0
17	284	76	0
18	127	45	0
19	0	1059	1395
20	0	335	886
21	210	78	136
22	125	106	223

Table 3. Cod biomass (mt) index by strata sections of eastern Georges Bank (see Figure 2) from the NMFS spring survey. Shaded cells represent missing values calculated from adjacent strata sections. Blank cells represent missing values assumed to be zero while "0" represents observed zeros.

	USA 16	CAN 16	USA 17	CAN 17	USA 18	CAN 18	USA 19	USA 20	USA 21	CAN 21	USA 22	CAN 22	USA total	CAN total
1968	1543	2053		313		16	2762	0	335	70	0		4640	2451
1969	1876	4015	0	264	0	0	2413	2882	452	0		0	7623	4278
1970	948	4877	0	375	0	28	520	809	164	0		0	2441	5280
1971	3071	4267	0	258	0	0	2376	383	0	365		0	5830	4890
1972	1322	5875	0	69	0	0	3749	1378	68	669		32	6518	6645
1973	16082	13420		136	0	195	6119	47331	275	1004	405	279	70212	15035
1974	8700	13169	0	230		32	2681	260	92	872	0	68	11733	14370
1975	2515	3220	0	370		12	6365	20482	20	287		119	29382	4008
1976	2017	2302		567		5	4949	5985	81	527	0		13032	3402
1977	694	2118	0	218	0	0	2073	1872	227	2055	100	0	4966	4391
1978	3959	6849	25	627	0	9	2584	407		2262	155	2627	7129	12375
1979	2044	5988	0	405		94	436	751	711	1357	206	42	4148	7885
1980	6542	10355	83	460		123	995	981	152	655	112	212	8865	11805
1981	4839	1927	103	894			2235	3654	489	821	72	1495	11391	5137
1982	476	123809	27	146	222	286	460	2591		483	196	993	3972	125717
1983	549	7246	246	784	0	93	0	8737	619	588	106	253	10258	8963
1984	1532	1527	78	239	0	0	793	4797	0	250	301	223	7500	2240
1985	1142	9618	29	57	0	159	2886	3032		1239		675	7088	11747
1986	1504	5622	103	45	0	13	2824	298	23	1712		425	4751	7817
1987	1430	3370	0	497	0	23	549	804	74	305		250	2856	4444
1988	1236	4560	0	334		42	1403	243	60	1229	0	269	2942	6432
1989	583	4630	0	33		9	1875	550	0	250		0	3008	4923
1990	1128	4693	0	519		146	475	449	57	108		603	2110	6068
1991	559	3512		178		157	1920	154	115	617		36	2748	4499
1992	0	2116		293		9	491	316	55	639		1240	862	4296
1993	749	695		1322		0	2229	472		134		229	3451	2380
1994	143	0	0	21	0		96	43	36	658		73	318	752
1995	350	7548		63	0		302	503		265		150	1154	8026
1996	1161	1545		221		0	1211	74	358	1653	0	0	2803	3419
1997	756	1561	11	107	0	28	471	0	116	176		343	1355	2214
1998	235	6238	0	187		72	0		110	5408	186	263	531	12168
1999	1053	2482	0	13		0	337	667	0	338	495	25	2552	2858
2000	1458	3281	0	11	0		967	1513	27	302		96	3965	3691
2001	191	1795		59		0	275	166	207	155		340	839	2349
2002	1341	2243	0	23		46	318		0	477	0	64	1659	2851
2003	478	3194	25	50		0	387	61	242	318	149	131	1342	3694
2004	309	2252		12		119	252	2462	119	11393		0	3142	13776
2005	1235	1599	0	266	0		0	64		697	121	151	1420	2713
2006	3162	511	0	457		0	524	277	509	1011		0	4472	1979
2007	2287	1759	15	128	0	0	398	237	452	260		82	3388	2229
2008	1488	1669	0	18		0	368	300	6	788		345	2162	2820
2009	1024	2673	7	0	0	100	535	47	256	3045	37	0	1906	5817

Table 4. Cod biomass (mt) index by strata sections of eastern Georges Bank (see Figure 2) from the NMFS fall survey. Shaded cells represent missing values calculated from adjacent strata sections. Blank cells represent missing values assumed to be zero while "0" represents observed zeros.

	USA 16	CAN 16	USA 17	CAN 17	USA 18	CAN 18	USA 19	USA 20	USA 21	CAN 21	USA 22	CAN 22	USA total	CAN total
1963	385	6654	0	0	0		3851	2806	245	2313	0		7287	8968
1964	0	5453	0	230	0	0	1089	750		1180		0	1840	6864
1965	0	1328		32	0	42	0	125	143	386	27	322	295	2110
1966	0	1414	0	68	0	779	386	467	6	480	0	280	859	3021
1967	1799	1421	0	1661	0	228	2876	1908	98	386		96	6682	3793
1968	0	226	0	445		134	515	640	81	432		849	1236	2087
1969	23	495	0	104		37	309	516	45	316	0	772	893	1723
1970	0	461	0	0		249	1445	1718	143	679		286	3306	1674
1971	19	1439	0	744	0	0	1089	2165	11	131		0	3285	2314
1972	815	2016		314	0	0	0	0	138	310	0		953	2639
1973	54	3215	0	572	0	149	1944	5096	33	949			7128	4886
1974	0	601	0	0	0	46	0	1227	0	2160	0	0	1227	2807
1975	0	2742		323	0	182	0	1094	18	255	0	10	1112	3513
1976	79	3547	0	21	0	36	51	1150	87	1148	0	71	1367	4824
1977	165	1770	0	475	0	322	602	2963	423	1353	253	129	4407	4050
1978	0	4898	0	345	0	213	1684	303	1105	744	242	557	3333	6756
1979	1084	7191	0	225		747	914	1141	157	754	40	40	3336	8957
1980	0	784	0	1049	0	34	529	805	11	536	39	182	1385	2585
1981	65	3498	31	1156	0	36	713	588	80	701	18	41	1495	5431
1982	0	382		250		0	0	491	11	655	146	0	648	1286
1983	0	352		74	0	36	0	255	15	1289	18		288	1751
1984	0	3745		495	0	838	0	244		345	0		244	5423
1985	0	1926		189	0	85	0	1	9	98		16	10	2313
1986	138	722		217	0	102	0	0	710	147	0	0	848	1187
1987	0	1359		52		260	0	0	166	294	51	41	217	2006
1988	0	2154		251		610	2	6		385	30	1400	38	4799
1989	0	2329		216	0		0	7	3	893	23	13	33	3451
1990	12	2647	0	285		27	0	0		1014		16	12	3989
1991	0	118		109	0			0	0	88	0	7	0	322
1992	57	643	0	704		0	0	35	13	380		57	105	1784
1993	0	92		188		0	0	0		54		26	0	361
1994	0	56		157		201	0	0	7	1583		0	7	1997
1995	0	23		127		71	0	67	28	1171	0		95	1392
1996	0	652		311		48	0		66	181		93	66	1284
1997	0	0		57		0	0	0		1285		0	0	1342
1998	0	1031		31		170	0	0		769			0	2001
1999	0	58		154		56	0	0		465	22	15	22	748
2000	0	269		226		48	0	0	0	234	0	0	0	778
2001	40	423		431		0	0	0	0	288		9	40	1151
2002	0	2955	0	366		34	207	0	0	7312	61	16	268	10684
2003	0	133		0		0	135	0	0	405		23	135	561
2004	0	5982	0	485	0	50	0	0	41	731	61	0	102	7247
2005	0	486	0	445	0	40	0	77	32	366	0	102	109	1440
2006	59	1781	0	0	0	0	0			190		0	59	1972
2007	0	149	0	34		0	47	47	4	214		21	98	418
2008	0	368	0	131		73	0	0		108		23	0	704
2009	0	973	0	11	0	0	0	332	0	724	24	31	356	1738

Table 5. Cod biomass (mt) index by strata and strata sections of eastern Georges Bank (see Figure 2) from the DFO survey.

	CAN 5Z1	CAN 5Z2	USA 5Z3	USA 5Z4	USA total	CAN total
1987	1555	5826	1345	98	1443	7381
1988	1894	12927	3856	775	4631	14821
1989	2040	8664	2766	1076	3842	10704
1990	1708	48900	4622	1435	6057	50608
1991	2204	17398	3820	1646	5467	19601
1992	2087	7602	4005	887	4892	9689
1993	719	9427	3875	2524	6399	10146
1994	817	11821	455	47	502	12638
1995	919	3277	3368	553	3921	4197
1996	1090	22489	3927	4667	8594	23579
1997	377	7336	2095	1196	3290	7714
1998	332	4091	551	32	583	4423
1999	211	6880	1206	880	2086	7092
2000	228	21947	9281	842	10123	22174
2001	1499	15563	257	718	975	17062
2002	2298	17043	309	683	992	19341
2003	720	3571	1130	797	1927	4291
2004	685	4248	699	29	728	4933
2005	1597	7306	192	17105	17298	8903
2006	127	8469	2652	1299	3951	8595
2007	836	8930	911	552	1462	9766
2008	5880	6603	327	848	1175	12483
2009	2195	20917	0[1]	54	54	23113

[1]No cod were caught in 7 tows in this stratum section.

Table 6. Haddock biomass (mt) index by strata sections of eastern Georges Bank (see Figure 2) from the NMFS spring survey. Shaded cells represent missing values calculated from adjacent strata sections. Blank cells represent missing values assumed to be zero while "0" represents observed zeros.

	USA 16	CAN 16	USA 17	CAN 17	USA 18	CAN 18	USA 19	USA 20	USA 21	CAN 21	USA 22	CAN 22	USA total	CAN total
1968	4767	5197		856		84	4637	1012		29	226	203	10642	6367
1969	11660	2342	0	1141	0	0	1914	71	0	44	152	137	13797	3664
1970	36753	2583	0	448	0	0	1381	120	201	73	18	159	38474	3263
1971	1102	469	0	194	3	0	1215	0	240	38		1097	2561	1798
1972	1017	3843	0	20	0	0	856	0	278	393		0	2151	4256
1973	2320	5270		113	0	0	1546	207	42	86	0	1284	4116	6752
1974	718	13765	0	77		6	4334	0		194	0		5052	14042
1975	4047	7002	0	59		0	1203	0	24	8076		34	5273	15171
1976	1955	1802		229		0	1003		2	856	0		2961	2887
1977	323	3283	0	43	0	0	1165	1242	41	13720	0	0	2771	17046
1978	6884	11740	6	56	0	24	2520	0	121	9148		151	9531	21119
1979	3715	12218	10	84		0	1049	0	103	987	260	2005	5137	15294
1980	21009	6764	13	263		67	26933		0	18795	82	96	48036	25985
1981	12286	15870	2	44			9096	3890		4215	370	944	25642	21073
1982	3830	8719	131	348	0	11	1200	859		2342	91	1029	6112	12450
1983	1487	5525	21	668	0	0	0	708	61	3999	464	368	2741	10559
1984	3539	4784	8	168	0	0	1497		2	154	120	170	5166	5276
1985	1793	8819	14	99	0	18	167	0		3696		54	1974	12686
1986	1210	6880	0	21	0	0	367	0	0	1297		0	1578	8197
1987	245	7607	0	101	0	17	0	1005		63		69	1250	7856
1988	3085	2097	0	13		0	169	0	0	310	0	0	3255	2419
1989	5778	2961	28	146		79	123	0	0	751		256	5929	4193
1990	1612	8848	0	64			0	0	33	1305		21	1645	10238
1991	1012	6001		37		0		0	0	28		0	1012	6067
1992	442	1530		80		0	93	0		376		0	536	1986
1993	266	3234		439		0	0	0		387		154	266	4214
1994	2	801	11	1	0		0		6	5644		0	19	6446
1995	2297	578	42	60	0		778	0	2	3356		888	3119	4881
1996	3720	1021	23	32		0	8581	0	8	972	31	0	12362	2026
1997	218	1884	10	28	0	11	0	0	45	1239		74	273	3237
1998	574	6600	3	84		5	0		282	227	0	108	859	7024
1999	6267	3485	0	1598		0	0	74	42	366	37	38	6420	5487
2000	4238	3712	0	220	0		198	668	522	151		55	5626	4138
2001	297	1537		446		0	71	0	1215	4339		15	1583	6337
2002	13973	9781	0	332		15	8094		0	897	93	78	22161	11103
2003	2149	14472	2	77		0	699	291	1123	1438	19	46	4282	16034
2004	25198	27752		978		75	3503	28736	715	669		3	58152	29477
2005	1575	3031	680	948	0		4991	144		3945	132	484	7522	8408
2006	11166	8302	5	323		97	758	3059	143	4140		40	15131	12901
2007	9617	23430	7	64	0	90	19906	12979	295	795		124	42804	24502
2008	40456	5465	2	135		164	87	1869	484	151		204	42898	6120
2009	22760	4635	88	245	0	37	1061	1502	6546	6224	0	19	31957	11159

Table 7. Haddock biomass (mt) index by strata sections of eastern Georges Bank (see Figure 2) from the NMFS fall survey. Shaded cells represent missing values calculated from adjacent strata sections. Blank cells represent missing values assumed to be zero while "0" represents observed zeros.

	USA 16	CAN 16	USA 17	CAN 17	USA 18	CAN 18	USA 19	USA 20	USA 21	CAN 21	USA 22	CAN 22	USA total	CAN total
1963	12153	8911	0	1892	0	2127	27496	1401	541	2689	240	194	41832	15814
1964	26324	5986	227	851	0	957	25601	9150	1531	2158	442	34	63275	9986
1965	6109	8981		773	0	687	16273	2064	112	2492	498	1114	25056	14047
1966	2640	8170	26	142	0	287	11825	1985	6	308	618	210	17100	9115
1967	1372	1700	0	448	22	304	2377	425	1884	193		360	6080	3005
1968	0	8032	0	129		377	0	71	21	0		651	92	9188
1969	599	0	0	146		0	1107	1927		86	0	102	3633	333
1970	27	743	8	555		542	9156	0	32	1035		274	9223	3149
1971	244	361	0	356	0	57	2463	0	112	29		470	2819	1272
1972	151	1143		685	0	43	0	0	0	0	72	204	223	2076
1973	83	9296	0	811	0	26	0	0		36			83	10169
1974	0	586	0	99	0	35	0		0	560	341	0	341	1279
1975	560	747		1322	0	226	0	425		0	37	540	1022	2835
1976	0	44340	0	375	0	307	0			9637	152	724	152	55381
1977	4	2886	0	623	0	510	88	0	482	24478	253	3131	827	31628
1978	133	1848	0	6727	0	1074	475	9	0	872	120	490	737	11010
1979	2561	2193	5	143		871	0	2		730	575	3233	3143	7171
1980	5	1228	0	4167	0	394	647	44	228	363	51	850	974	7002
1981	647	4886	213	2349	0	348	5	20	266	570	316	552	1467	8705
1982	162	1919		2889		1423	0	0	26	60	128	14	316	6305
1983	95	334		1061	0	506	0	0		197	262	333	357	2431
1984	0	308		1603	0	455	0	0		71	152	194	152	2632
1985	497	590		739	0	395	0	0	7	453		18	504	2195
1986	0	2368		1383	0	465	0	0	16	2079	0	26	16	6321
1987	7	8		320		140	8	7	0	205	0	239	22	911
1988	50	1134		366		1588	0	0		1724	0	413	50	5224
1989	4	528		987	2	1114	0	8	6	1331	46	296	66	4257
1990	51	29	0	1396		401	0	0		885		132	51	2842
1991	20	92		561	0	0		0	8	0	0	178	28	831
1992	171	292	0	585		173	0	8	0	6		21	179	1077
1993	0	443		217		0	0	0		4103		83	0	4846
1994	0	0		284		347	0	0	0	1162		0	0	1793
1995	4	5214		843		1373	0	0	0	6575	0		4	14005
1996	10	2057		1138		639	0		1	179		0	10	4012
1997	0	4		133		0	2	5	8	6012		0	15	6149
1998	7	3409		285		471	0	37	7	2241			51	6406
1999	0	151		113		2021	0	0		13900	0	0	0	16184
2000	100	1646		365		1351	0	0	0	9432	0	0	100	12795
2001	1013	1471		2264		395	0	0	0	21540		491	1013	26161
2002	314	21420	8	591		201	0	144	0	19620	206	223	671	42054
2003	2736	3312		331		95	342	219	123	6453		0	3420	10121
2004	3275	24845	746	1115	0	693	0	5	1766	8248	223	1181	6014	36083
2005	5647	13381	2	1071	0	98	3	120	585	5617	2650	11761	9009	31927
2006	2088	20548	0	837	0	571	0			4502		7275	2088	33732
2007	203	2560	6	788		39	0	0	11208	2860		15315	11417	21561
2008	89	2578	2	4246		775	0	0		8005		7470	91	23074
2009	11523	15663	0	1635	0	0	12254	1059	240	3999	188	36	25263	21333

Table 8. Haddock biomass (mt) index by strata and strata sections of eastern Georges Bank (see Figure 2) from the DFO survey.

	CAN 5Z1	CAN 5Z2	USA 5Z3	USA 5Z4	USA total	CAN total
1987	2661	12956	375	99	475	15617
1988	1350	16559	8305	96	8401	17909
1989	982	9377	641	198	839	10359
1990	3943	15963	3424	4155	7579	19907
1991	3084	13597	7383	3260	10643	16680
1992	3544	10403	5953	576	6530	13946
1993	2064	2367	110	2411	2521	4432
1994	8871	9968	19	90	108	18839
1995	2244	18041	336	0	336	20285
1996	4947	16985	440	839	1279	21933
1997	1853	11022	1298	179	1476	12875
1998	15844	29323	89	11	99	45167
1999	14775	15221	506	319	825	29996
2000	4682	41522	11048	158	11206	46205
2001	9471	43754	2022	513	2535	53225
2002	5695	28569	3391	11863	15254	34264
2003	1583	89462	4334	27407	31741	91045
2004	21198	71574	5479	1796	7274	92772
2005	9638	39589	1931	5209	7140	49226
2006	5445	53525	35052	6285	41337	58970
2007	9705	43079	3811	5009	8820	52784
2008	35446	47657	34798	6063	40861	83102
2009	29750	41728	0[1]	82	82	71478

[1]No haddock were caught in 7 tows in this stratum section.

Table 9. Yellowtail flounder biomass (mt) index by strata and strata sections of Georges Bank (see Figure 2) from the NMFS spring survey. Blank cells represent missing values assumed to be zero while "0" represents observed zeros.

	USA 13	USA 14	USA 15	USA 16	CAN 16	USA 17	CAN 17	USA 18	CAN 18	USA 19	USA 20	USA 21	CAN 21	USA total	CAN total
1968	326	0	0	1228	413		0		0	1052	99	0	0	2705	413
1969	2239	0	0	1524	633	22	0	0	0	7425	107	100	0	11416	633
1970	2975	0	0	773	156	29	0	0	0	1359	653	17	0	5806	156
1971	2114	29	0	1146	183	0	0	0	0	1284	0	49	0	4622	183
1972	2056	10	0	1505	1307	0	0	0	0	1979	214	0	0	5764	1307
1973	1204	6	0	862	611		5	0	0	367	83	5	317	2528	932
1974	782	0	0	623	522	0	0		0	870	214	0	0	2488	522
1975	258	17	0	344	781	0	0		0	349	89	0		1057	781
1976	835	0	0	375	674		6		0	430	107	2	0	1748	680
1977	152	7	0	124	666	0	0	0	0	30	20	0	37	332	703
1978	224	7	0	119	180	0	3	0	0	159	90	7	0	607	182
1979	312	0	0	193	422	5	9		0	315	20	5	0	849	432
1980	933	0	0	387	2300	0	131		2	389	81	2	4	1793	2437
1981	211	9	0	1035	137	0	25			185	19	0	73	1459	235
1982	1202	0	3	175	563	0	10	0	4	694	0	10	0	2084	578
1983	355	13	0	431	799	0	73	0	3	1023	161	16		1999	875
1984	135	0	0	342	747		0	0	0	265	201	16	0	960	747
1985	127	0	0	200	473	0	0	0	3	131	55	0	0	512	475
1986	190	0	0	68	584	0	0	0	0	71	0	9	20	338	604
1987	66	0	0	114	102	0	0	0	0	71	0	2	0	253	102
1988	193	0	0	183	146	0	0		0	46	6	40	0	467	146
1989	179	0	0	115	322	0	0		0	65	2	2	3	363	324
1990	545	0	0	30	117	0	7			37	0	0	0	612	124
1991	233	0	0	139	286		0		0	7	0	0	0	380	286
1992	295	0	0	178	1200		9		0	169	45	0	25	688	1233
1993	84	0	0	83	349		8		0	49	0	0	6	217	363
1994	103	0	0	127	383	0	0	0		70	0	55	37	356	419
1995	298	0	0	439	1854		0	0		41	12	4	44	794	1898
1996	103	0	0	1020	1724		9		0	229	120	13	23	1485	1756
1997	95	0	0	432	3631	0	0	3	0	35	59	2	0	626	3631
1998	704	0	0	910	676	0	0		0	38	65	19	302	1737	978
1999	768	0	0	2571	6830	0	0		0	5	67	36	3	3448	6833
2000	681	0	0	2003	4927	0	6	0		180	33	61	0	2956	4933
2001	61	0	0	2486	2389		8		0	101	20	240	17	2908	2413
2002	66	0	0	3656	3876	0	0		0	663	8	4	3150	4397	7026
2003	173	0	0	895	6384	0	28		0	21	0	14		1103	6412
2004	261	0		535	1219		0		0	74	16	0	62	886	1281
2005	216	0	0	2094	1025	0	0	0		44	0	0	33	2354	1058
2006	93	5	0	1258	1051	0	0		0	87	58	2	2	1504	1053
2007	372	382	3	733	3271	0	6	0	0	38	81	89	0	1699	3277
2008	234	0	0	968	1241	44	969		0	92	22	28	29	1388	2239
2009	1150	0	0	4298	5566	61	116	0	0	338	16	69	104	5933	5786

Table 10. Yellowtail flounder biomass (mt) index by strata and strata sections of Georges Bank (see Figure 2) from the NMFS fall survey. Blank cells represent missing values assumed to be zero while "0" represents observed zeros.

	USA 13	USA 14	USA 15	USA 16	CAN 16	USA 17	CAN 17	USA 18	CAN 18	USA 19	USA 20	USA 21	CAN 21	USA total	CAN total
1963	6254	153	15	1741	477	84	41	5		2136	3102	13	0	13502	518
1964	10125	60	0	1102	114	26	33	0	0	3324	113	0	7	14751	154
1965	6677	24	0	247	80		17	0	0	1451	1419	62	0	9879	97
1966	669	0	0	164	1336	5	5	0	0	1351	353	25	4	2566	1345
1967	1622	10	23	2359	0	119	0	0	0	2202	495	0	0	6830	0
1968	2864	0	0	2143	1491	9	0		0	4178	323	5	0	9521	1491
1969	2927	0	0	1859	298	86	0		0	3738	156	7	0	8773	298
1970	1519	0	0	632	424	75	0		0	2206	318	62	0	4812	424
1971	3359	19	9	1766	179	0	0	3	4	1222	0	137	0	6514	183
1972	4504	29	0	1827	306		0	0	0	339	0	232	0	6930	306
1973	1867	0	0	2225	2377	5	0	0	0	178	13	349	36	4638	2414
1974	2286	0	0	749	825	0	0	0	0	126	0	0	0	3160	825
1975	770	19	0	936	747		0	0	0	80	36	0	0	1842	747
1976	128	0	0	1070	167	0	75	0	0	17	63	55	34	1333	276
1977	139	123	0	712	1765	0	7	0		109	91	60	0	1235	1772
1978	1129	0	0	838	336	0	78	0	0	151	31	1	0	2151	414
1979	479	0	0	739	156	0	5		0	9	45	48	4	1320	165
1980	40	14	0	1975	3869	8	26	0	0	970	93	110	173	3211	4068
1981	941	0	0	1250	106	0	0	0	0	190	0	22	0	2403	106
1982	1512	0	0	110	603		0		0	105	23	42	0	1792	603
1983	753	0	0	731	676		0	0	0	0	0	141	0	1625	676
1984	304	0	0	201	85		5	0	0	31	0	45	17	581	108
1985	141	0	0	405	171		4	0	0	0	0	0	38	547	212
1986	208	0	0	438	155		0	0	0	8	2	4	0	659	155
1987	69	0	0	193	267		0		0	16	0	0	0	278	267
1988	18	0	0	121	60		0		0	0	4	0	13	144	73
1989	794	0	0	202	83		0	0		9	21	0	0	1026	83
1990	388	0	0	282	76	0	0		0	32	0	0	0	702	76
1991	90	0	0	661	99		0	3		0	0	25	0	779	99
1992	177	0	0	9	419	0	0		0	16	22	0	0	224	419
1993	47	0	0	24	327		12		0	0	7	18	0	96	339
1994	113	0	0	105	755		18		0	11	0	118	19	347	792
1995	47	0	0	80	214		0		0	3	10	71	0	211	214
1996	90	0	0	1494	284		0		0	0	0	10	0	1593	284
1997	232	0	0	1808	1999		0		0	38	0	37	3	2115	2003
1998	818	0	0	592	2364		3		0	0	20	5	0	1435	2367
1999	770	0	0	2935	3962		191		0	224	114	157	0	4200	4154
2000	171	0	0	5580	1097		4		0	60	22	144	20	5978	1121
2001	641	0	0	7877	2139		13		0	177	47	111	0	8853	2153
2002	161	0	0	1784	1861	0	7		0	5	10	214	75	2174	1943
2003	92	0	0	2825	1613		0		0	158	0	43	3	3119	1616
2004	161	0	0	5915	78	0	0	0	0	172	12	67	121	6327	198
2005	145	0	0	1133	1260	0	7	0	0	41	29	56	9	1404	1276
2006	1475	0		2909	294	0	45	1	0	25	3	16	37	4429	376
2007	274	0	0	5739	753	3	0	0	0	52	6	114	115	6188	868
2008	852	0	0	3090	3654	0	0		0	0	0	31	58	3973	3712
2009	3803	0	0	9376	664	0	30	0	0	1089	131	161	136	14560	830

Table 11. Yellowtail flounder biomass (mt) index by strata of Georges Bank (see Figure 2) from the DFO survey. The biomass index which results when a very large tow on the Canadian side in 2008 and 2009 are excluded are also reported.

	CAN 5Z1	CAN 5Z2	USA 5Z3	USA 5Z4	USA total	CAN total
1987	69	750	102	343	445	819
1988	30	253	136	816	952	283
1989	29	111	50	281	331	140
1990	39	358	129	1053	1181	397
1991	57	444	262	996	1258	501
1992	119	432	327	1599	1925	550
1993	59	1634	178	771	949	1693
1994	91	501	745	1417	2162	591
1995	35	785	487	719	1206	820
1996	35	2799	1229	1241	2470	2833
1997	868	2464	2431	7529	9960	3332
1998	93	2484	613	1102	1715	2577
1999	190	6616	408	10452	10860	6806
2000	2019	5526	6430	5974	12404	7545
2001	443	4995	963	15757	16720	5438
2002	66	5052	5854	9727	15581	5118
2003	48	5739	75	10387	10462	5786
2004	84	5637	63	3271	3334	5720
2005	51	1028	392	11886	12278	1079
2006	35	776	962	4805	5767	812
2007	196	2959	102	10088	10189	3155
2008	64491	1656	262	910	1172	66147
2008[1]	1276	1656	262	910	1172	2932
2009	70851	1077	45	72	117	71927
2009[1]	14509	1077	45	72	117	15585

[1]One very large tow on Canadian side excluded.

Table 12. Resource distribution for eastern Georges Bank cod on the Canadian and USA sides of the international boundary for the NMFS and DFO surveys, the distribution resulting from combining the surveys and the smoothed resource distribution. The combined distribution was obtained by averaging the NMFS spring and DFO surveys to represent winter-spring and subsequently averaging with NMFS fall which represented summer-fall. Open box highlights current year results.

	NMFS fall		NMFS spring		DFO		combined		smooth	
	%CAN	%USA	%CAN	%USA	%CAN	%USA	%CAN	%USA	%CAN	%USA
1977	48	52	47	53			47	53	56	44
1978	67	33	63	37			65	35	58	42
1979	73	27	66	34			69	31	61	39
1980	65	35	57	43			61	39	64	36
1981	78	22	31	69			55	45	65	35
1982	67	33	97	3			82	18	65	35
1983	86	14	47	53			66	34	67	33
1984	96	4	23	77			59	41	69	31
1985	100	0	62	38			81	19	71	29
1986	58	42	62	38			60	40	74	26
1987	90	10	61	39	84	16	81	19	78	22
1988	99	1	69	31	76	24	86	14	82	18
1989	99	1	62	38	74	26	83	17	85	15
1990	100	0	74	26	89	11	91	9	85	15
1991	100	0	62	38	78	22	85	15	85	15
1992	94	6	83	17	66	34	85	15	85	15
1993	100	0	41	59	61	39	76	24	84	16
1994	100	0	70	30	96	4	91	9	83	17
1995	94	6	87	13	52	48	82	18	83	17
1996	95	5	55	45	73	27	80	20	84	16
1997	100	0	62	38	70	30	83	17	84	16
1998	100	0	96	4	88	12	96	4	84	16
1999	97	3	53	47	77	23	81	19	85	15
2000	100	0	48	52	69	31	79	21	85	15
2001	97	3	74	26	95	5	90	10	84	16
2002	98	2	63	37	95	5	88	12	84	16
2003	81	19	73	27	69	31	76	24	83	17
2004	99	1	81	19	87	13	91	9	80	20
2005	93	7	66	34	34	66	71	29	78	22
2006	97	3	31	69	69	31	73	27	79	21
2007	81	19	40	60	87	13	72	28	80	20
2008	100	0	57	43	91	9	87	13	81	19
2009	83	17	75	25	100	0	85	15	**83**	**17**

Table 13. Resource distribution for eastern Georges Bank haddock on the Canadian and USA sides of the international boundary for the NMFS and DFO surveys, the distribution resulting from combining the surveys and the smoothed resource distribution. The combined distribution was obtained by averaging over all surveys. Open box highlights current year results.

	NMFS fall		NMFS spring		DFO		combined		smooth	
	%CAN	%USA	%CAN	%USA	%CAN	%USA	%CAN	%USA	%CAN	%USA
1977	97	3	86	14			92	8	84	16
1978	94	6	69	31			81	19	80	20
1979	70	30	75	25			72	28	77	23
1980	88	12	35	65			61	39	75	25
1981	86	14	45	55			65	35	73	27
1982	95	5	67	33			81	19	74	26
1983	87	13	79	21			83	17	78	22
1984	95	5	51	49			73	27	82	18
1985	81	19	87	13			84	16	84	16
1986	100	0	84	16			92	8	84	16
1987	98	2	86	14	97	3	94	6	84	16
1988	99	1	43	57	68	32	70	30	83	17
1989	98	2	41	59	93	7	77	23	82	18
1990	98	2	86	14	72	28	86	14	80	20
1991	97	3	86	14	61	39	81	19	82	18
1992	86	14	79	21	68	32	78	22	84	16
1993	100	0	94	6	64	36	86	14	86	14
1994	100	0	100	0	99	1	100	0	86	14
1995	100	0	61	39	98	2	86	14	88	12
1996	100	0	14	86	94	6	69	31	89	11
1997	100	0	92	8	90	10	94	6	87	13
1998	99	1	89	11	100	0	96	4	86	14
1999	100	0	46	54	97	3	81	19	85	15
2000	99	1	42	58	80	20	74	26	81	19
2001	96	4	80	20	95	5	91	9	78	22
2002	98	2	33	67	69	31	67	33	76	24
2003	75	25	79	21	74	26	76	24	74	26
2004	86	14	34	66	93	7	71	29	72	28
2005	78	22	53	47	87	13	73	27	69	31
2006	94	6	46	54	59	41	66	34	66	34
2007	65	35	36	64	86	14	62	38	63	37
2008	100	0	12	88	67	33	60	40	60	40
2009	46	54	26	74	100	0	57	43	57	43

Table 14. Resource distribution for Georges Bank yellowtail flounder on the Canadian and USA sides of the international boundary for the NMFS and DFO surveys, the distribution resulting from combining the surveys and the smoothed resource distribution. The combined distribution was obtained by averaging over all surveys. Open box highlights current year results. Values in brackets "( )" are results of an analysis which excluded a very large tow on the Canadian side from the 2008 and 2009 DFO surveys.

	NMFS fall		NMFS spring		DFO				combined				smooth			
	%CAN	%USA	CAN	USA	%CAN		%USA		%CAN		%USA		%CAN		%USA	
1977	59	41	68	32					63		37		42	(42)	58	(58)
1978	16	84	23	77					20		80		37	(37)	63	(63)
1979	11	89	34	66					22		78		32	(32)	68	(68)
1980	56	44	58	42					57		43		28	(28)	72	(72)
1981	4	96	14	86					9		91		25	(25)	75	(75)
1982	25	75	22	78					23		77		26	(26)	74	(74)
1983	29	71	30	70					30		70		27	(27)	73	(73)
1984	16	84	44	56					30		70		32	(32)	68	(68)
1985	28	72	48	52					38		62		36	(36)	64	(64)
1986	19	81	64	36					42		58		37	(37)	63	(63)
1987	49	51	29	71	65		35		48		52		36	(36)	64	(64)
1988	34	66	24	76	23		77		27		73		32	(32)	68	(68)
1989	7	93	47	53	30		70		28		72		30	(30)	70	(70)
1990	10	90	17	83	25		75		17		83		31	(31)	69	(69)
1991	11	89	43	57	28		72		28		72		37	(37)	63	(63)
1992	65	35	64	36	22		78		51		49		42	(42)	58	(58)
1993	78	22	63	37	64		36		68		32		48	(48)	52	(52)
1994	70	30	54	46	21		79		48		52		51	(51)	49	(49)
1995	50	50	71	29	40		60		54		46		51	(51)	49	(49)
1996	15	85	54	46	53		47		41		59		50	(50)	50	(50)
1997	49	51	85	15	25		75		53		47		50	(50)	50	(50)
1998	62	38	36	64	60		40		53		47		48	(48)	52	(52)
1999	50	50	66	34	39		61		52		48		46	(46)	54	(54)
2000	16	84	63	37	38		62		39		61		44	(44)	56	(56)
2001	20	80	45	55	25		75		30		70		43	(43)	57	(57)
2002	47	53	62	38	25		75		44		56		41	(41)	59	(59)
2003	34	66	85	15	36		64		52		48		40	(40)	60	(60)
2004	3	97	59	41	63		37		42		58		38	(38)	62	(62)
2005	48	52	31	69	8		92		29		71		36	(36)	64	(64)
2006	8	92	41	59	12		88		20		80		40	(40)	60	(60)
2007	12	88	66	34	24		76		34		66		43	(42)	57	(58)
2008	48	52	62	38	98	(71)	2	(29)	69	(60)	31	(40)	46	(46)	54	(54)
2009	5	95	49	51	100	(99)	0	(1)	52	(51)	48	(49)	**50**	**(50)**	**50**	**(50)**

Table 15. Resource utilization and distribution of eastern Georges Bank cod and haddock and Georges Bank yellowtail flounder (Ytl) and the weightings used in the Canada/USA allocation sharing formula. Allocation shares are updated annually based on resource distribution. The weighting of resource utilization to resource distribution changes from an initial ratio of 40:60 to 10:90 by 2010.

	Resource Utilization		
	Cod	Haddock	Ytl
USA	40%	45%	98%
CANADA	60%	55%	2%

	Resource Distribution				*Resource Utilization and Distribution Weighting*			*Allocation Shares*		
	Survey Year	Cod	Haddock	Ytl	Fishing Year	Utilization	Distribution	Cod	Haddock	Ytl
USA	**2000**	18%	20%	54%	**2002**	40%	60%	27%	30%	72%
CANADA		82%	80%	46%				73%	70%	28%
USA	**2001**	14%	16%	64%	**2003**	40%	60%	24%	28%	78%
CANADA		86%	84%	36%				76%	72%	22%
USA	**2002**	12%	26%	62%	**2004**	40%	60%	23%	34%	76%
CANADA		88%	74%	38%				77%	66%	24%
USA	**2003**	18%	27%	56%	**2005**	35%	65%	26%	33%	71%
CANADA		82%	73%	44%				74%	67%	29%
USA	**2004**	14%	29%	56%	**2006**	30%	70%	22%	34%	69%
CANADA		86%	71%	44%				78%	66%	31%
USA	**2005**	21%	29%	63%	**2007**	25%	75%	26%	33%	72%
CANADA		79%	71%	37%				74%	67%	28%
USA	**2006**	26%	32%	73%	**2008**	20%	80%	29%	35%	78%
CANADA		74%	68%	27%				71%	65%	22%
USA	**2007**	29%	36%	73%	**2009**	15%	85%	31%	37%	77%
CANADA		71%	64%	27%				69%	63%	23%
USA	**2008**	23%	40%	60%	**2010**	10%	90%	25%	40.5%	64%
CANADA		77%	60%	40%				75%	59.5%	36%
USA	**2009**	17%	43%	50%	**2011**	10%	90%	19%	43%	55%
CANADA		83%	57%	50%				81%	57%	45%

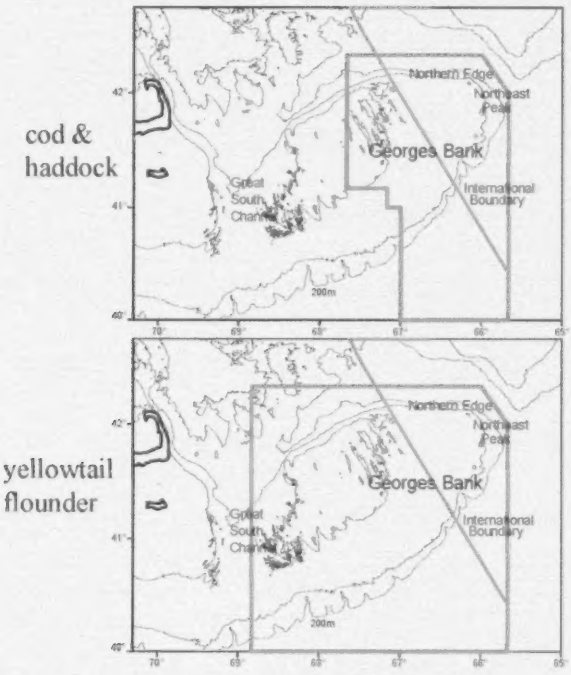

Figure 1. The management areas for cod and haddock (upper panel) and yellowtail flounder (lower panel) on Georges Bank and the Canada/USA boundary line across which resource distribution was determined.

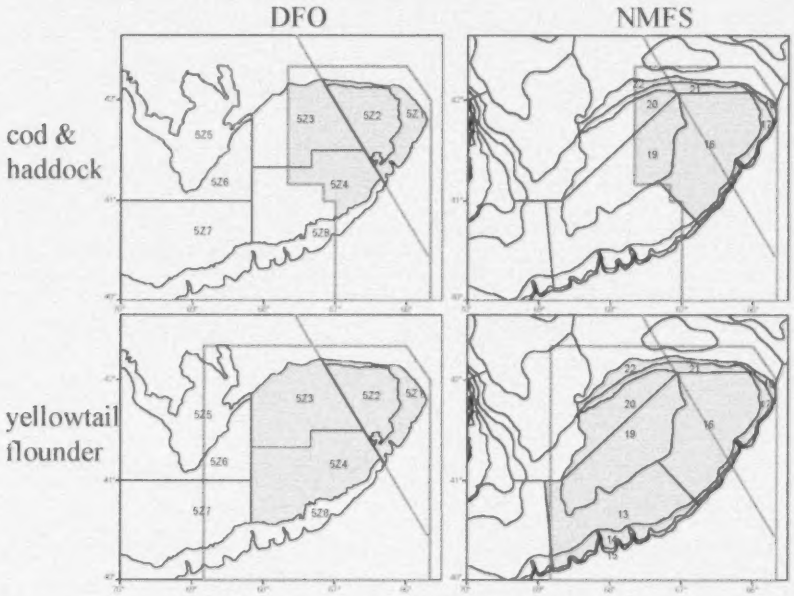

Figure 2. DFO and NMFS survey strata used to develop biomass indices on either side of the Canada/USA boundary for Eastern Georges Bank cod and haddock and Georges Bank yellowtail flounder in relation to the management unit borders. Strata boundaries (thin black lines) with strata labels are shown. The shaded area represents the strata and strata sections that were used to approximate the respective management units (thick grey lines).

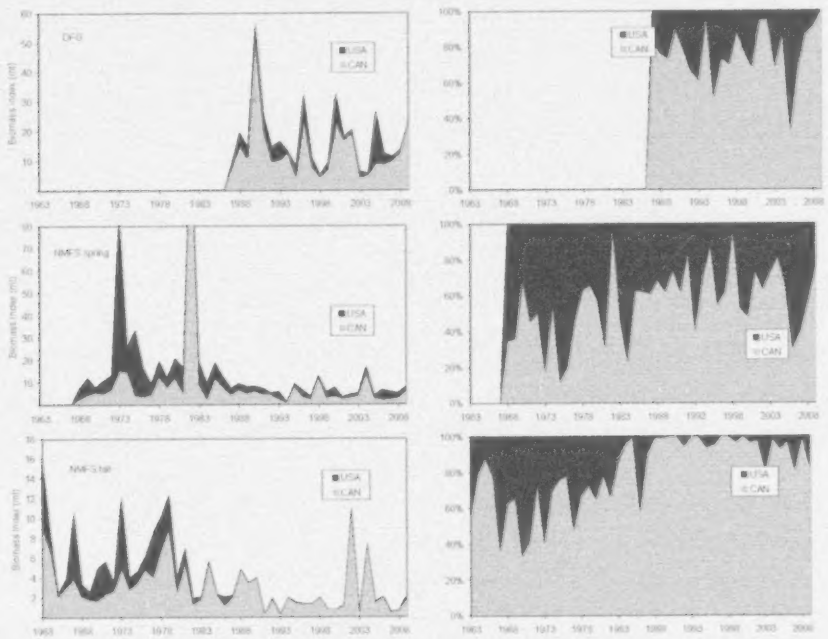

Figure 3. Relative indices of biomass and percentage resource distribution in relation to the international boundary for cod on eastern Georges Bank.

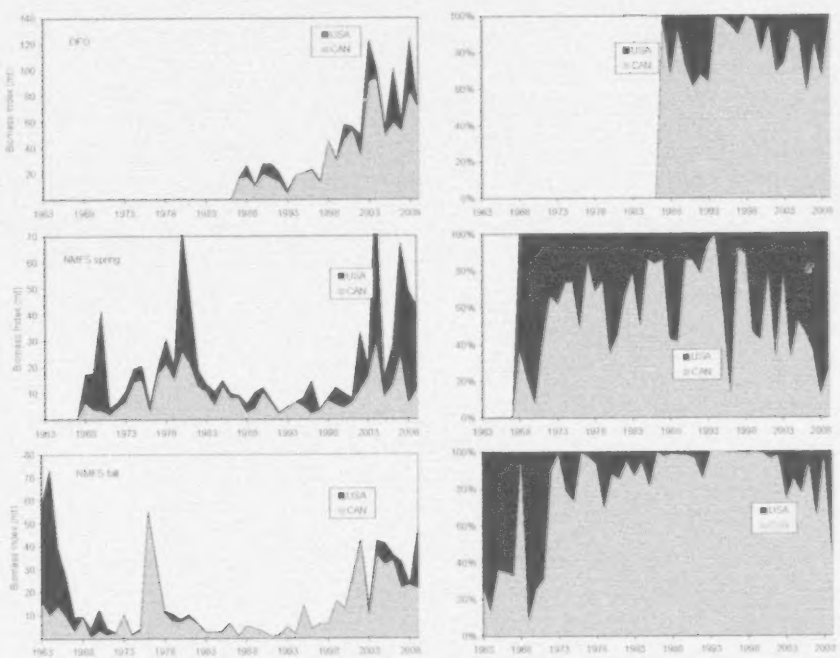

Figure 4. Relative indices of biomass and percentage resource distribution in relation to the international boundary for haddock on eastern Georges Bank.

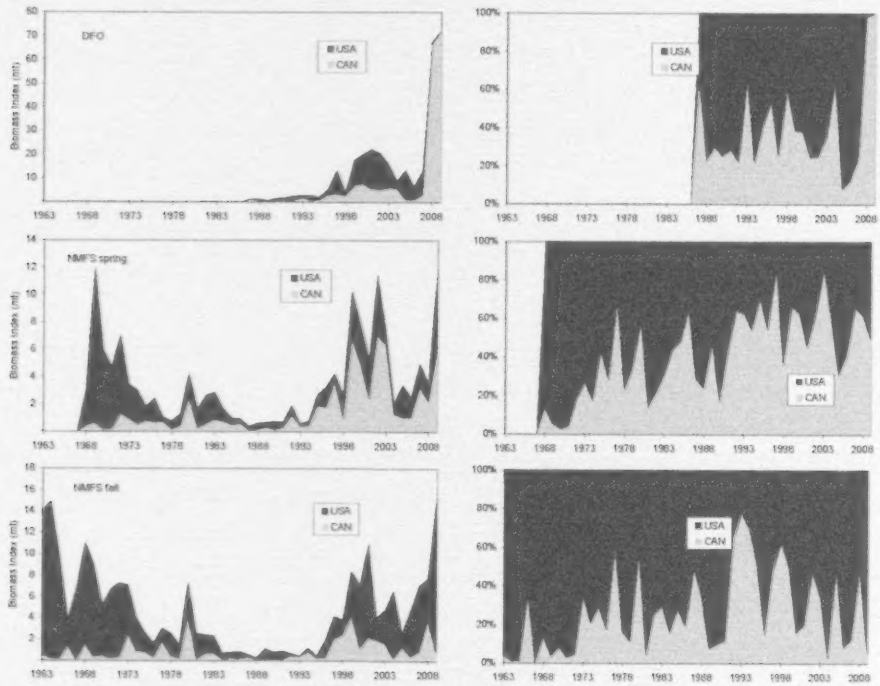

Figure 5. Relative indices of biomass and percentage resource distribution in relation to the international boundary for yellowtail flounder on Georges Bank.

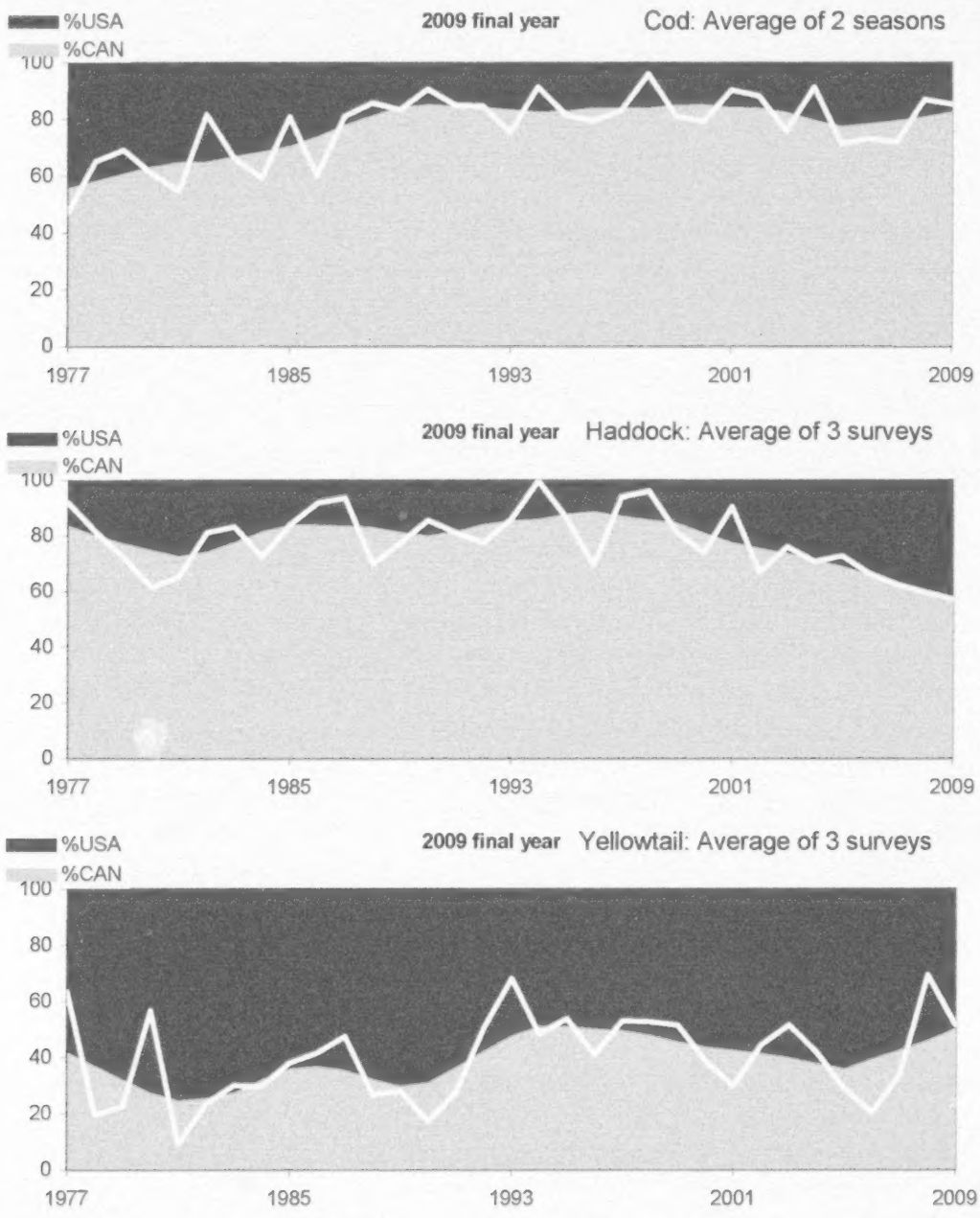

Figure 6. Observed annual percentage (white line) and smoothed trends of proportion of eastern Georges Bank cod and haddock and of Georges Bank yellowtail flounder on the Canadian side of the international boundary.